United States
Department of
Agriculture

Forest
Service

Forest
Products
Laboratory

Dividends From Wood Research

Recent Publications

January–June 1990

Explanation and Instructions

"Dividends From Wood Research" is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory (FPL). These publications are produced to encourage and facilitate application of Forest Service research. This issue lists publications received from the printer by the FPL Publications Section between January 1, 1990, and June 30, 1990.

Each publication listed is available through at least one of the sources below. For each entry, we indicate the primary source for that publication and show you how to obtain a copy:

Available from FPL (indicated by an order number before the title of the publication): Quantities limited. Circle the number on the order blank and mail it to the FPL.

Available through sales outlets (indicated by the name of the outlet and, when available, price information): Major sales outlets are the Superintendent of Documents, the National Technical Information Service (NTIS), and various private publishers. Order directly from the outlet.

Available through libraries: Research publications are available through many public and university libraries in the United States and elsewhere. U.S. Government publications are also available through many Government Depository Libraries. Check with a major library near you to determine availability.

List of Categories

Publications are listed within the following general categories:

Anatomy and Identification

1. Wood Identification of Commercially Important North American Species of Birch (*Betula*)

Miller, Regis B.; Cahow, Eric
IAWA Bull. n.s. 10(4): 364–373; 1989.

The wood anatomy was studied of the four commercially important North American species of birch: *Betula alleghaniensis, B. lenta, B. nigra,* and *B. papyrifera.* Although the wood from these species is fairly homogeneous, it appears that *B. papyrifera* can be separated from *B. nigra*; *B. alleghaniensis* and *B. lenta*, although indistinguishable from each other, can be separated from both *B. papyrifera* and *B. nigra.* In addition to these species, two commercially important European species (*B. pendula* and *B. pubescens*) and two additional North American tree species (*B. occidentalis* and *B. populifolia*) were studied. A dichotomous key to all eight species is presented.

2. Identification of the Heath-Leaved Cypress, *Chamaecyparis thyoides* 'Ericoides' (Cupressaceae)

Miller, Regis B.; Meyer, Frederick G.
Baileya. 23(2): 57–67; 1989.

Cultivated forms of conifers with juvenile leaves pose problems of identification that are not easily reconciled by conventional methods. The wood from a specimen of the heath-leaved cypress (*Chamaecyparis thyoides* 'Ericoides') was examined to correctly identify this juvenile-leaved cultivar. The taxonomic, nomenclatural, and historical aspects of this cultivar are reviewed in this paper.

Biodeterioration and Protection

3. Fungal Resistance of Southern Pine Impregnated With Methyl Fluorophenyl Carbamates or Reacted With Fluorophenyl Isocyanates

Chen, George C.; Rowell, Roger M.; Ellis, W. Dale
Wood and Fiber Sci. 32(2): 165–172; 1990.

This paper describes how the fungal toxicity of fluorophenyl isocyanates reacted with wood. Methyl fluorophenyl carbamates were also synthesized and impregnated into wood to compare bonded and nonbonded toxicity.

4. Outdoor Wood Weathering and Protection

Feist, William C.
In: Rowell, Roger M.; Barbour, R. James, eds. Archaeological wood: properties, chemistry, and preservation. Advances in Chemistry Series 225. Proceedings of 196th meeting of the American Chemical Society; 1988 September 25–28; Los Angeles. Washington, DC: American Chemical Society. Chapter 11.

This paper discusses the influence of outdoor weathering on the performance of wood. The chemical and physical changes of wood exposed outdoors are described, and the mechanisms of weathering and methods for protecting exposed wood surfaces are summarized. The studies described have implications for the preservation of historical structures.

5. Performance of Surface Finishes Over CCA-Treated Wood

Feist, William C.; Ross, Alan S.
In: Executive Summaries; 43rd annual meeting; 1988 June; Reno, NV. Madison, WI: Forest Products Research Society; 1988: 4–5.

This paper summarizes studies that evaluated the performance of transparent and pigmented commercially available finishes and coatings over CCA-treated wood and determined the extent of the chromium enhancement effect.

6. Antagonism of *Scytalidium lignicola* Against Wood Decay Fungi

Highley, T.L.
Doc. No. IRG/WP/1392. The International Research Group on Wood Preservation. Working Group I a Biological Problems (Flora): 1989. 14 p.

Antagonistic abilities of *Scytalidium lignicola* against white- and brown-rot wood decay fungi were evaluated. *S. lignicola* did not produce inhibition zones but overgrew the decay fungi on a malt-agar medium and in most cases killed them. Pretreatment of Douglas-fir and Southern Pine blocks with *S. lignicola* prevented decay. Blocks that were heated or treated with propylene oxide to kill the antagonist were not decay resistant. Thus, *S. lignicola* does not confer a residual fungistatic effect to wood. *S. lignicola* was able to eradicate all the decay fungi in wood except for *Postia placenta* and *Gloeophyllum trabeum*. Wood blocks treated with filter-sterilized filtrates of *S. lignicola* were not decay resistant, and filtrates were not inhibitory to growth of the decay fungi in agar medium. The antagonistic effect, therefore, apparently does not involve toxins.

7. Wood Decay: New Concepts and Opportunities for Control

Highley, Terry L.
In: Proceedings, 85th annual meeting, American Wood-Preservers' Association; 1989 April 23–26; San Francisco, CA. Stevensville, MO: American Wood-Preservers' Association; 1989: 71–77. Vol. 85.

In this paper, the author discusses new developments in the understanding of wood decay and the opportunities these might present for controlling decay.

8. Effect of Aromatic Monomers on Production of Carbohydrate-Degrading Enzymes by White-Rot and Brown-Rot Fungi

Highley, Terry L.; Micales, Jessie A.
FEMS Microbiology Letters. 66: 15–22; 1989.

This paper discusses the effects of 12 monomeric aromatic compounds on the production of six carbohydrate-degrading enzymes of two brown-rot fungi, *Postia placenta* and *Gloeophyllum trabeum*, and one white-rot fungus, *Coriolus versicolor*.

9. Decomposition of Wood by Brown-Rot Fungi

Illman, Barbara L.; Highley, Terry L.
Biodeterioration Res. 2: 465–484; 1989.

This paper presents an overview of the decomposition of wood by brown-rot fungi, the most important and destructive form of decay in wood products. Special emphasis is given in chemistry, biochemistry, and unique physiological features that might be manipulated for control purposes.

10. Comparison of Preservative Treatments in Marine Exposure of Small Wood Panels

Johnson, Bruce R.; Gutzmer, David I.
USDA Forest Serv. Res. Note FPL–RN–0258; 1990. 28 p.

This report compares the effectiveness of 300 preservative treatments in protecting small wood panels from teredinids and *Limnoria* for periods up to 19 years. The report includes several treatments not previously reported or included in earlier publications on the original study.

11. Practical Preservation Procedures for Beehive Bodies

Kalnins, Martins A.; Boone, R. Sidney; Gutzmer, David I.
Am. Bee J. May: 337–340; 1990.

This article describes the conditions that were used in two hot and cold bath treatments and in a vacuum treatment. It also gives the penetrations and retentions of preservative that were obtained from these treatments. The treated hive bodies will be placed in service in Florida and will be observed for durability.

12. Predicting Effectiveness of Wood Preservatives From Small Sample Field Trials

Link, Carol L.; De Groot, Rodney C.
Wood and Fiber Sci. 22(1): 92–108; 1990.

This paper explores alternative methods of presenting information about preservative-treated stakes in field trials to reflect data variability. Using parametric and nonparametric procedures, this paper also discusses the feasibility of using early failures in a group of replicate stakes to predict the sample median of that group.

13. Statistical Issues in Evaluation of Stake Tests

Link, Carol L.; De Groot, Rodney C.
In: Proceedings of the 85th annual meeting of the American Wood-Preservers' Association; 1989 April

23–26; San Francisco, CA. Stevensville, MD: American Wood-Preservers' Association; 1989: 179–185. Vol. 85.

This paper explores some statistical issues in the evaluation of stake tests: accounting for data variability, choice of rating scale for evaluating termite and decay damage, definition of failure, and replicability of experimental results. Data used to illustrate these issues come from 50 years of field tests conducted by the Forest Products Laboratory. These issues need to be considered as researchers are trying to improve their estimate of future benefits that could be expected from new preservatives.

14. Extracellular Glucan Production by *Postia (= Poria) placenta*

Micales, Jessie A.; Richter, Adrian L.; Highley, Terry L.
Mater. Org. 24(4): 259–269; 1989.

It has been reported that an isolate of the brown-rot fungus *Postia placenta* (Fr.) M. Lars. and Lomb. is unable to degrade wood. This isolate, ME20 is able to produce extracellular carbohydrate-degrading enzymes, H_2O_2, and oxalic acid, all thought to be essential to the wood degrading process. Liquid cultures of ME20 are not as viscous as those of *P. placenta*, which are able to degrade wood (personal observation). Therefore, the objective of the study was to determine whether the production and degradation of extracellular glucan by ME20 varies from that of other isolates of *P. placenta*.

15. Analytical Methods for Evaluating the Effects of Acidic Deposition at the Paint–Wood Interface on Painted Wood

Williams, R. Sam
Interagency Agreement No. DW 12931510. Atmospheric Research and Exposure Assessment Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711; 1988: 27 p.

This report briefly reviews the literature and outlines research at the Forest Products Laboratory in cooperation with the Environmental Protection Agency under the National Acid Precipitation Assessment Program. The various sections focus on the analytical techniques developed to assess the incremental degradation of the paint–wood interface from acid deposition. The methods that were developed should be applicable to both laboratory and field testing of painted wood. The research resulted in methods for detecting sulfur compounds at the paint–wood interface using energy dispersive x-ray analysis, evaluating the effect of chemical changes in paint adhesion, and identifying degradation products of wood using ^{13}C nuclear magnetic resonance spectroscopy.

16. Photodegradation of Wood Affects Paint Adhesion

Williams, R. Sam; Plantinga, Pamela L.; Feist, William C.
Forest Prod. J. 40(1): 45–49; 1990.

This article evaluates paint adhesion in several species exposed for 4 or 8 weeks during the summer. This exposure was typical of the degradation that newly installed wood siding might undergo prior to painting. Adhesion was determined by a shear test similar to that used for testing wood-adhesive bonds, and test results were compared with the results for western redcedar from a previous study. The same primers were used in both studies. The decrease in paint adhesion to weathered wood is correlated with paint performance on wood panels that are currently being exposed outdoors. The ultimate objective of this research is to relate initial paint adhesion to long-term finish performance.

Chemicals From Wood

17. Chemistry of Other Components in Naval Stores

Conner, Anthony H.
In: Zinkel, Duane F.; Russell, James, eds. Naval Stores—Production, Chemistry, Utilization. New York: Pulp Chemicals Association; 1989. Chapter 11: 440–475.

This chapter reviews the chemistry of neutral constituents found in naval stores. It includes discussions about the types and occurrence of neutrals, their physical properties, and methods used for their identification. In addition, reasons and methods for removing neutrals from naval stores are discussed. In particular, a number of methods for removing neutral constituents from tall oil and its fractions are identified.

18. Gas Chromatography of Resin Acids With A Methyl Silicone Fused-Silica Capillary Column

Han, James S.; Zinkel, Duane F.
Naval Stores Review. 100(1): 11–15; 1990.

This paper reports on exploring operational parameters for a methyl silicone column for achieving maximum resolution for the common resin acids, yet reducing analysis time when samples contain oxygenated resin acids.

Energy

19. Sources and Uses of Wood for Energy

Zerbe, John I.
In: Contemporary concepts in technology and policy: Proceedings, International symposium, Energy options for the year 2000; 1988: 1.243–1.254.

This paper reviews how wood has been utilized for energy in the past. It explains the sources of wood fuel, the continued availability to supply our needs for wood, fiber products, and energy, and the advantages and disadvantages of expanding the use of wood for energy.

Engineering Properties and Design Criteria

20. Design Stresses for Hardwood Structural Grades Create New Opportunities

DeBonis, A.L.; Bendtsen, B. Alan
In: Executive Summaries; 43rd annual meeting; 1988 June; Reno, NV. Madison, WI: Forest Products Research Society; 1988: 48–50.

One reason why the use of hardwoods for structural applications has been limited is the lack of recommended allowable design stresses for the vast majority of species and species groupings. This paper outlines the advances recently made in this area, defines some of the markets currently utilizing the design stresses developed, and focuses attention on several areas of research required in the near future to improve utilization of hardwood resources.

21. Computer Programs for Adjusting the Mechanical Properties of 2-Inch Dimension Lumber for Changes in Moisture Content

Evans, James W.; Evans, Jane K.; Green, David W.
USDA Forest Serv. Gen. Tech. Rep. FPL–GTR–63; 1990. 18 p.

This report presents computer programs for adjusting the mechanical properties of 2-in. dimension lumber for changes in moisture content. Mechanical properties adjusted are modulus of rupture, ultimate tensile stress parallel to the grain, ultimate compressive stress parallel to the grain, and flexural modulus of elasticity. The models are valid for moisture contents from 8 to 23 percent (assumed green value). Although test results can be adjusted for moisture content, such adjustments decrease in accuracy with increasing change in moisture content. For this reason, the specimens should be conditioned as closely as possible to the target moisture content prior to test.

22. Nondestructive Testing of Wood Products and Structures: State-of-the-Art and Research Needs

Falk, R.H.; Patton–Mallory, M.; McDonald, K.A.
In: doe Reis, Henrique L.M., ed. Nondestructive testing and evaluation for manufacturing and construction: Proceedings of conference; 1988 August 9–12; Champaign, IL. New York: Hemisphere Publishing Corp.; 1990: 137–147.

This paper overviews nondestructive testing research as it is applied to wood products and structures and discusses areas of research needed to more fully utilize this technology. Specifically, the discussion includes acoustic techniques such as sonically and ultrasonically induced stress waves, acoustic emissions, and acousto-ultrasonics. Other methods, including optical scanning, electrical resistance, and those relying on the ability of wood to transmit waves in the form of x-rays or microwaves, are discussed. Methods incorporating mechanical vibration characteristics, such as transverse vibrations, are also included.

23. Thermal Effects on Load-Duration Behavior of Lumber. Part II: Effect of Cyclic Temperature

Fridley, Kenneth J.; Tang, R.C.; Soltis, Lawrence A.
Wood and Fiber Sci. 22(2): 204–216; 1990.

A multiphased research program having the overall goal to evaluate and model the effect of the environment on the load-duration, also known as creep-rupture, behavior of structural lumber is currently in progress at Auburn University and is conducted in cooperation with the Forest Products Laboratory. The first phase involved the testing and modeling of the load-duration behavior in various constant temperature environments. Little information is available with respect to cyclic temperature; therefore, the second phase of the research program was designed to investigate and model the load-duration behavior of lumber under cyclic temperature and constant humidity environments and is the focus of this paper.

24. Moisture Content and Tensile Strength of Douglas Fir Dimension Lumber

Green, David W.; Pellerin, Roy F.; Evans, James W.; Kretschmann, David E.
USDA Forest Serv. Res. Pap. FPL–RP–497; 1990. 33 p.

This study investigated the effect of moisture content on the ultimate tensile stress of Douglas Fir dimension lumber. This paper presents the experimental procedure and results.

25. Effects of Fire Retardant Treatments on Wood Strength: A Review

LeVan, Susan L.; Winandy, Jerrold E.
Wood and Fiber Sci. 22(1): 113–131; 1990.

This paper examines the factors that might influence the degradation of fire-retardant-treated wood and to expand understanding of these factors to improve design and performance of products made from treated wood.

26. Prefabricated Wood Composite I-Beams: A Literature Review

Leichti, Robert J.; Falk, Robert H.; Laufenberg, Theodore L.
Wood and Fiber Sci. 22(1): 62–79; 1990.

This paper reviews the available literature on the state of the art of prefabricated wood composite I-beams. The results of analytical and experimental investigations illustrate the effects of materials, joint, geometry, and environment on the short- and long-term performance of I-beams.

Prefabricated Wood I-Joists: An Industry Overview

Leichti, Robert J.; Falk, Robert H.; Laufenberg, Theodore L.
Forest Prod. J. 40(3): 15–20; 1990.

Available from Robert J. Leichti, Department of Forest Products, Oregon State University, Corvallis, OR 97331. No cost.

This article presents the results of a survey that was primarily intended to provide an overview of the wood I-beam industry. Research needs also are identified.

27. Stress-Laminated Wood Bridge Decks

Oliva, Michael G.; Dimakis, Al G.; Ritter, Michael A.; Tuomi, Roger L.
USDA Forest Serv. Res. Pap. FPL–RP–495; 1989. 24 p.

This report presents results of recent research completed on solid wood stress-laminated decks. The primary objective was to quantify the behavior of the bridge decks when loaded with simulated truck loadings. Identification of an accurate analytical technique for predicting deck response and development of a new simplified prestressing anchorage system were also achieved. Objectives were

accomplished through an experimental laboratory test program on full-size bridges followed by computer-aided analytical correlation studies. A summary of the project and experimental and analytical results is presented with conclusions and recommendations for tasks that should be completed before stress-laminated decks are used in bridge construction.

28. Teaching Aids for Timber Engineering and Design

Soltis, Lawrence A.
In: Education and continuing development for the civil engineer—setting the agenda for the 90's and beyond: Proceedings of the national forum; 1990 April 17–20; Las Vegas, NV. New York: American Society of Civil Engineers; 1990: 123–130.

The objectives of this paper are to encourage teaching of timber engineering and to describe the teaching materials that are available. In addition, this information may help educators to plan the engineering curriculum and coursework.

29. Modeling the Effect of Out-of-Plane Fiber Orientation in Lumber Specimens

Stahl, Douglas C.; Cramer, Steven M.; McDonald, Kent
Wood and Fiber Sci. 22(2): 173–192; 1990.

In this paper, a method is presented to account for the effect of three-dimensional fiber orientations near knots in a two-dimensional lumber tensile strength prediction model.

30. Effects of Waterborne Preservative Treatments on the Mechanical Properties of Wood

Winandy, Jerrold E.
In: Executive Summaries; 43rd annual meeting; 1988 June; Reno, NV. Madison, WI: Forest Products Research Society; 1988. p. 1.

This paper briefly summarizes how waterborne preservative treatments effect mechanical properties of wood. It also outlines the presentation given on this subject during the 1988 Forest Products Research Society 43rd Annual Meeting.

31. ACA and CCA Preservative Treatment and Redrying Effects on Bending Properties of Douglas-Fir

Winandy, Jerrold E.; Boone, R. Sidney, Gjovik, Lee R.; Plantinga, Pamela L.
In: Proceedings, 85th annual meeting, American Wood-Preservers' Association; 1989 April 23–26; San Francisco, CA. Stevensville, MO: American Wood-Preservers' Association; 1989: 106–118. Vol. 85.

This report evaluates the effects of two waterborne preservative treatments, ammoniacal copper arsenate and chromated copper arsenate, and subsequent redrying of temperatures of $\leq 170°F$ ($77°C$) on the bending properties of small, clear specimens of Douglas-fir. In addition, the possibility of a differential effect on bending strength resulting from differences in initial treatability of specimens was studied.

Fiber and Particle Products

32. Ring Flakes From Small-Diameter Eastern Hardwoods

Carll, Charles G.
USDA Forest Serv. Res. Note FPL–RN–0257; 1989. 11 p.

The study described in this paper was conducted to examine the ring-flaking characteristics of some eastern hardwoods. Small-diameter eastern hardwood stems of various densities were maxichipped and ring flaked. The flakes were evaluated by screen analysis and measured for length, width, bulk density, and ash and silica content.

33. Compressive Creep Behavior of Paperboard in a Cyclic Humidity Environment—Exploratory Experiment

Considine, J.M.; Thelin, P.; Gunderson, D.E.; Fellers, C.
In: Perkins, R.W., ed. Mechanics of cellulosic and polymeric materials: Proceedings, 3d Joint ASCE/ASME Mechanics conference; 1989 July 9–12; San Diego. New York: The American Society of Mechanical Engineers; 1989: 149–156.

This study revealed two important findings: creep rate and stiffness loss rate are directly related, and they appear to be good predictors of failure. This testing procedure offers potential as a tool for determining the load-carrying ability of paperboard in uncontrolled environments. Also published in Tappi J. 72(11): 131–136; 1989.

34. User-Friendly Programming for a Computerized Laboratory Press

Geimer, Robert L.; Kinney, Richard; Podlipec, Mark
Forest Prod. J. 40(3): 41–44; 1990.

A computerized press control and data gathering program developed at the USDA Forest Service, Forest Products Laboratory, allows researchers to manipulate small changes in the pressing variables for wood-based composites and to observe the responses. Knowledge of a few basic principles permits the researcher an opportunity to use complex computer programs. This report describes (1) segmented programs capable of controlling a press in conjunction with auxiliary (steam injection) devices; (2) means of acquiring a smooth transition from the dynamic to the static mode of control; and (3) techniques for collecting critical data.

35. Bending-Creep Tests on Acetylated Pine and Birch Particle Boards During White and Brown-Rot Fungal Attack

Imamura, Y.; Rowell, R.M.; Simonson, R.; Tillman, A-M.
Paperi ja Puu 70(9): 816–820; 1988.

The purpose of this investigation was to subject control and acetylated pine and birch particleboards made using melamine-urea-formaldehyde resin to pure culture brown- and white-rot fungal attack and determine weight losses, and to apply the bending-creep test for evaluation of strength losses during white or brown-rot fungal attack.

36. Analysis of the Localized Buckling in Composite Plate Structures With Application to Determining the Strength of Corrugated Fiberboard

Johnson, M.W., Jr.; Urbanik, T.J.
J. Composites Technol. Res. 11(4): 121–127; 1989.

This study examines the theory for elastic buckling of composite structures composed of long rectangular flat plate elements.

37. Preliminary Results of Panel Products Creep and Creep–Rupture Research Program

Laufenberg, Theodore L.; McNatt, Dobbin
In: Maloney, Thomas M., ed. Proceedings of the 23d international particleboard/composite materials symposium; 1989 April 4–6; Pullman, WA. Pullman, WA: Washington State University; 1989: 257–266.

The preliminary results of a test program to provide creep and creep–rupture information for composite panel products are summarized in this paper. Commercially produced plywood and oriented strandboard were tested to identify those products that provided the high, low, and median flexural creep performance. Three plywood and three oriented strandboard products were tested extensively to provide information on their duration of load and creep performance.

38. Concentrated Load and Impact Behavior of Wood-Based Panels

Laufenberg, Theodore L.; Xu, Dan Ping; McNatt, Dobbin
In: Maloney, Thomas M., ed. Proceedings, 23d international particleboard/composite materials symposium; 1989 April 4–6; Pullman, WA. Pullman, WA: Washington State University; 1989. p. 280.

This paper is a summary of a research study that was presented at the 1989 23d international particleboard/composite materials symposium. In this research, a Navier–Levy orthotropic plate analysis was developed and utilized in solving concentrated and impact loading problems. For static concentrated loads, the method allows prediction of deflections at any loading position in a single span plate. The findings from this research will be useful in developing new test procedures for panel products and will aid in assessing concentrated and impact load effects on existing or new products.

39. Opportunities for Combining Wood With Nonwood Materials

Youngquist, John A.; Rowell, Roger M.
In: Maloney, Thomas M., ed. Proceedings of the 23d international particleboard/composite materials symposium; 1989 April 4–6; Pullman, WA. Pullman, WA: Washington State University; 1989: 141–157.

This paper reviews the scope of opportunities that are available for various wood–nonwood combinations; it discusses raw material options for producing new composites; it reviews the range of properties that can be obtained with alternative blends of materials. It also looks at the economics and marketing aspects of several product options. The application of this potential technology falls into both price- and performance-driven composites.

Fire Safety

40. Correlation of Wood Smoke Produced from NBS Smoke Chamber and OSU Heat Release Apparatus

Tran, H.C.
In: Hasegawa, H.K., ed. Characterization and toxicity of smoke, ASTM STP 1082. Philadelphia, PA: American Society for Testing and Materials; 1990: 135–146.

In this study, smoke generation from red oak and Douglas-fir plywood using the National Bureau of Standards (NBS) smoke density chamber in the smoldering mode at 2.0, 2.5, and 3.0 W/cm^2 of heating flux was examined. The data included optical density and particulate (soot) mass concentration, both as a function of time and heating flux. Data from the NBS chamber was compared to data from a dynamic smoke measurement apparatus, the Ohio State University (OSU) calorimeter. Because of basic differences between the NBS chamber and the OSU apparatus and between the units of measurement used in these methods, the results were reduced to a common unit, particulate mass per unit area of exposed specimen surface. Comparison of the data at 2.5 W/cm^2 of heating flux showed reasonable agreement.

41. Heat Release From Wood Wall Assemblies Using Oxygen Consumption Method

Tran, Hao C.; White, Robert H.
In: Nelson, Gordon L., ed. Fire and polymers: Hazards identification and prevention. ACS symposium series 425. Proceedings of 197th national meeting of the American Chemical Society; 1989 April 9–14; Dallas, TX. Washington, DC: American Chemical Society; 1990. Chapter 25.

The concept of heat release rate is gaining acceptance in the evaluation of fire performance of materials and assemblies. However, this concept has not been incorporated into fire endurance testing such as the ASTM E–119 test method. Heat release rate of assemblies can be useful in determining the time at which the assemblies start to contribute to the controlled fire and the magnitude of heat contribution. Twelve wood wall assemblies were tested in an ASTM E–119 fire endurance furance at the USDA Forest Service, Forest Products Laboratory. Heat release measurements using the oxygen consumption method were a part of this program. This paper discusses the accuracy of this method.

Microbial and Biochemical Technology

42. Respiratory Efficiency and Metabolite Partitioning as Regulatory Phenomena in Yeasts

Alexander, M.A.; Jeffries, T.W.
Enzyme Microb. Technol. 12: 2–19; 1990.

Recent work has shown that aerobic fermentation results from an inherently limited respiratory capacity of some yeasts, rather than from a specific repression of respiration. Nevertheless, considerable enzymatic evidence exists that suggests that a Crabtree effect does indeed operate in some yeasts, specifically *Saccharomyces cerevisiae*. Because multiple electron transport systems are known to exist in yeasts, repression of the normal ATP-producing system can be accompanied by the induction

of an alternate pathway. No decrease in the overall rate of oxygen utilization would then be apparent. Repression would, however, affect the yield of ATP from oxidative metabolism. This effect should be detectable using a suitable analysis of growth energetics. To this end, a model has been developed and applied to a variety of yeasts to examine them for changes in respiratory efficiency indicative of a Crabtree effect. A Crabtree effect consistent with previous enzymatic findings was detected in *S. cerevisiae* and *S. uvarum* but not in *Schizosaccharomyces pombe*. In this paper, new regulatory classifications based on model findings are proposed and methods for independently verifying these findings are outlined.

43. Mn(II) Regulation of Lignin Peroxidases and Manganese-Dependent Peroxidases From Lignin-Degrading White Rot Fungi

Bonnarme, P.; Jeffries, T.W.
Appl. Environ. Microbiol. 56(1): 210–217; 1990.

Two families of peroxidases, lignin peroxidase (LiP) and manganese-dependent lignin peroxidase (MnP), are formed by the lignin-degrading white-rot basidiomycete *Phanerochaete chrysosporium* and other white-rot fungi. Isoenzymes of these enzyme families carry out reactions important to the biodegradation of lignin. This research investigated the regulation of LiP and MnP production by Mn(II).

44. Fermentation of D-Xylose and Cellobiose

Jeffries, Thomas W.
In: Verachtert, Hubert; De Mot, Rene, eds. Yeast—Biotechnology and Biocatalysis. New York: Marcel Dekker, Inc.; 1990. Chapter 12.

This chapter considers the major elements of the D-xylose utilization pathway, including relevant aspects of transport, assimilation, and regulation. The bulk of the chapter is concerned with fermentation of D-xylose to ethanol. Utilization of cellobiose and xylan also is covered, along with occasional or unique aspects of D-glucose metabolism as it occurs in D-xylose-fermenting yeasts. Effects of factors such as oxygen, temperature, and substrate and product concentrations, are reviewed, along with strain development, scale-up, and practical application of the technology.

45. Glyoxal Oxidase of *Phanerochaete chrysosporium*: Its Characterization and Activation by Lignin Peroxidase

Kersten, Philip J.
In: Proceedings of the National Academy of Science of the United States of America. 87(8): 2936–2940; 1990.

Glyoxal oxidase (GLOX) is an extracellular H_2O_2-producing enzyme found in ligninolytic cultures of *P. chrysosporium*. The enzyme catalyzes the oxidation of a number of simple aldehydes and α-hydroxy carbonyl compounds; two substrates of the oxidase, glyoxal and methylglyoxal, are also found in the extracellular fluid of ligninolytic cultures grown on defined medium. The temporal correlation of GLOX, lignin peroxidase, and oxidase substrate appearances in cultures suggests a close physiological connection between these components. The scale-up and purification of GLOX are reported, together with a characterization of the enzyme, not only of its physicochemical properties but also its dependence on a peroxidase system for activity. An extracellular regulatory mechanism for control of H_2O_2 production is apparent.

46. Recovery and Fractionation of the Extracellular Degradative Enzymes From *Lentinula edodes* Cultures Cultivated on a Solid Lignocellulosic Substrate

Mishra, Chittra; Leatham, Gary F.
J. Ferment. Bioeng. 69(1): 8–15; 1990.

The purpose of this study was to develop methods suitable for the rapid recovery and separation of the extracellular enzymes produced by cultures *L. edodes* grown on a commercial wood substrate. The use of anion exchange chromatography as an efficient initial fractionation step and screening column fractions with multiple substrates as a particularly effective method to visualize the enzyme activities present are described.

Mycology

47. Taxonomic Mycology: Concerns About the Present; Optimism for the Future

Burdsall, Harold H. Jr.
Mycologia 82(1): 1–8; 1990.

This paper is a discussion by the author of his current and future concerns for taxonomic mycologists to carry out systematic studies on fungi that cause wood to decay.

48. Influence of Calmodulin Antagonists on Production of Carbohydrate-Degrading Enzymes of Brown- and White-Rot Fungi

Highley, Terry L.
Mater. Org. 24(4): 241–250; 1989.

In this study, the effect of several anticalmodulin compounds on production of carbohydrate-degrading enzymes by brown- and white-rot fungi was evaluated.

49. Reexamination of the Nomenclatural Types of *Polyporus rimosus* Berk. and *P. badius* Berk.

Larsen, Michael J.
Mycotaxon XXXVII. April–June: 353–361; 1990.

Recent interpretation of the names *Phellinus rimosus* and *P. badius* are reviewed. The extant type material of *P. rimosus* was found to contain two different *Phelinus* species. Thus, *P. rimosus* is retypified, and an earlier name, *Polyporus igniarius* var. *scaber* (=*Phellinus scaber*), is used for the second species. *Phellinus badius* appears to be misapplied in a variety of senses, and, as proposed earlier, its application is restricted to the nomenclatural type.

50. A Cultural Study of Several Species of *Antrodia* (Polyporaceae, Aphyllophorales)

Lombard, Frances F.
Mycologia. 82(2): 185–191; 1990.

This paper reports on a cultural study of five species, three for which cultural descriptions are published. Unpublished cultural data for additional species are included also.

Processing of Wood Products

51. IMPROVE Lumber Drying Program

Danielson, Jeanne D.
In: Proceedings, Western Dry Kiln Association joint meeting; 1989 May 3–5; Corvallis, OR. Corvallis, OR: Western Dry Kiln Association; 1989: 40–45.

The IMPROVE system is a package of computer tools under development to measure and improve processing efficiency and product quality in sawmills, veneer mills, and plywood plants. Data collection procedures and computer software combine recovery improvement programs with many of the latest technological and research developments. This IMPROVE system gives primary processors an easily used system to analyze how effectively logs are being converted into end products, to identify opportunities to increase product yield and value, and to predict the results of proposed improvements.

52. Moisture in Building Envelopes

Quarles, Stephen L.; TenWolde, Anton
In: Executive Summaries; 43rd annual meeting; 1988 June; Reno, NV. Madison, WI: Forest Products Research Society; 1988: 19–20.

This paper is a brief discussion on needed research in the area of moisture in buildings. Future research needs to include mathematical modeling and field studies to confirm or evaluate design and construction guidelines for minimizing moisture problems, and sensor development to help ascertain realistic values for moisture fluxes and air flows.

53. Empirical Model to Correlate Press Drying Time of Lumber to Process and Material Variables

Simpson, William T.; Tang, Yi-fu
Wood and Fiber Sci. 22(1): 39–53; 1990.

This paper reports on a heat-transfer-based empirical model that relates press drying time of lumber to certain process and material variables. The potetial use of the model is for a segregation system that will group boards of similar drying times so that they can be dried together, thus reducing variability in final moisture content and taking fullest possible advantage of the warp suppression benefits of press drying. The model relates drying time to several board characteristics that can be measured at production line speed so that an immediate grouping decision can be made on each board just before drying. The model predicts the expected consequences of changing the process and material variables and has potential as the base for a segregation system.

Pulp, Paper, and Packaging

54. Analysis of High Levels of Wastepaper Use in the U.S. Pulp and Paper Industry, 2000–2040

Durbak, Irene A.; Howard, James L.; Lange, William J.; Ince, Peter J.
In: Forestry on the frontier: Proceedings of the 1989 Society of American Foresters national convention; 1989 September 24–27; Spokane, WA. Bethesda, MD: Society of American Foresters; 1990: 332–337.

Current legislative initiatives at the local, state, and Federal level are aimed at achieving higher levels of recovery of waste material currently deposited in landfill sites in the United States. In view of these initiatives, the USDA Forest Service evaluated the impact of higher levels of wastepaper use on regional pulpwood markets. An economic model, developed at the Forest Products Laboratory, was used to make regional projections of paper and paperboard production, pulpwood and recycled fiber consumption, and pulpwood prices under two scenarios: Base Case and High Recycled Fiber. This paper describes the methods and discusses the results of this Forest Service analysis of future high levels of wastepaper use in the U.S. pulp and paper industry using the High Recycled Fiber scenario.

55. Alternative Modeling Technology Scenarios in the North American Pulp and Paper Industry

Howard, James L.; Durbak, Irene; Ince, Peter J.
In: Proceedings of the forest sector analysis symposium; 1989 August 13–18; Soderfors, Sweden. Uppsala, Sweden: The Swedish University of Agricultural Science; 1989: 122–134.

The Pulpwood Model is an economic model of the present and future North American pulp and paper industry. Its principal objective is to project over the next 50 years regional pulpwood consumption in North America, incorporating likely changes in technology. The model also projects from the year 2000 to 2040 regional capacity and production by product grade and manufacturing process, regional wastepaper consumption, and long-range prices of raw materials and products. This paper describes certain flexibility features of the Pulpwood Model and details how the Pulpwood Model can be used to create and evaluate higher rates of wastepaper recovery and recycling for regional pulpwood markets in North America.

56. Modeling Future Technological Change and Fiber Consumption in the Pulp and Paper Industry

Howard, James L.; Durbak, Irene A.; Ince, Peter J.; Lange, William J.
In: Forestry on the frontier: Proceedings of the 1989 Society of American Foresters national convention; 1989 September 24–27; Spokane, WA. Bethesda, MD: Society of American Foresters; 1990: 327–331.

This paper describes the Pulpwood Model and highlights some of its major projections. The Pulpwood Model is an economic model of the present and future North American (United States and Canada) pulp and paper industry. Its principal objective is to project regional pulpwood consumption in North America over the next 50 years, incorporating likely changes in technology. The model also projects regional capacity and production by product grade and manufacturing process, regional wastepaper consumption, and long-range prices of raw materials and products.

57. Projected Pulpwood Consumption in the United States, 2000–2040: Implications for Timber Management?

Ince, Peter J.
In: Forestry on the frontier: Proceedings of the 1989 Society of American Foresters national convention; 1989 September 24–27; Spokane, WA. Bethesda, MD: Society of American Foresters; 1990: 364–369.

Hardwood pulpwood consumption is projected to more than double by the year 2040, while consumption of softwood pulpwood will increase by less than 50 percent. This paper discusses the extent to which forest management implications depend on the methods and scope of analysis that provide such projections. Results show that technology forecasting and future analysis must be directed at the broadest possible considerations to reach the most valid conclusions. Results also suggest that resource management implications drawn from long-range resource projections will depend on the extent to which methods simulate the behavioral response of technological change.

58. A PFI Mill Can Be Used to Predict Biomechanical Pulp Strength Properties

Leatham, Gary F.; Myers, Gary C.
Tappi J. 73(4): 192–197; 1990.

It has been shown that a biomechanical pulping process in which aspen chips are pretreated with a white-rot fungus can give energy savings and can increase paper sheet strength. To optimize this process, more efficient ways to evaluate the fungal treatments are needed. This paper reports on a method that consists of treating coarse refiner mechanical pulp, refining in a PFI mill, and testing for freeness. It discusses (1) why the PFI mill method successfully predicts strength properties rather than energy savings, (2) the limitations of the method, and (3) the implications of these results for developing a method to predict energy savings.

59. Biomechanical Pulping of Aspen Chips: Energy Savings Resulting From Different Fungal Treatments

Leatham, Gary F.; Myers, Gary C.; Wegner, Theodore H.
Tappi J. 73(5): 197–200; 1990.

This paper presents (1) the energy savings in mechanical pulping resulting from treatments with eight different fungi in either stationary or rotating bioreactors, (2) the stage at which most of the energy was saved, (3) the optimal treatment duration with a selected fungus and bioreactor, and (4) an initial attempt to determine the basis for treatment efficacy.

60. Biomechanical Pulping of Aspen Chips: Paper Strength and Optical Properties Resulting From Different Fungal Treatments

Leatham, Gary F.; Myers, Gary C.; Wegner, Theodore H.
Tappi J. 73(3): 249–255; 1990.

This paper reports the results of aspen chips treated with nine different fungi prior to mechanical pulping. Four-week treatment with white-rot fungi generally increased strength and decreased optical properties, except for zero-span tensile index and opacity, which were essentially unchanged. Treatment with a brown-rot fungus did not improve strength properties but decreased brightness and scattering coefficient. Chip movement inhibited chip degradation. Some of the white-rot fungal treatments that resulted in the lowest relative losses in chip weight (<5 percent) gave the highest strength properties. Detailed chemical analyses indicated that strength improvement by white-rot fungi does not correlate with the bulk removal of any material, including lignin. Also, no correlation was evident between increased strength and the resultant pulp fiber length index or handsheet density.

61. Delignification of Aspen Wood Using Hydrogen Peroxide and Peroxymonosulfate

Springer, Edward L.
Tappi J. 73(1): 175–178; 1990.

Treatment of finely divided aspen wood with peroxymonosulfate at low pH, followed by alkaline extraction, resulted in nearly complete lignin removal. Treatment of the wood with hydrogen peroxide at optimum pH (pH 11), followed by alkaline extraction, removed at most 36 percent of the original lignin. Peroxymonosulfate can be easily produced by mixing hydrogen peroxide with concentrated sulfuric acid.

62. Preserving Tall Oil and Turpentine in Stored Pine Chips Using Sodium N-Methyldithiocarbamate

Springer, Edward L.; Zinkel, Duane F.
In: TAPPI proceedings of the 1989 pulping conference; 1989 October 22–25; Seattle, WA. Atlanta, GA: TAPPI Press; 1989: 457–464.

In this study, fresh slash pine chips were treated by immersion in 0.44-percent and 0.22-percent solutions of sodium N-methyldithiocarbamate and stored under aerobic conditions in 4-ft^3 insulated boxes. Results showed that both high- and low-level treatments were effective in preserving the strength of pulp produced from the chips.

Timber Requirements and Economics

63. Entrepreneurial Opportunities for Secondary Manufacturing With Hardwoods: Sources of Evolving Technology and Technology Transfer

Erickson, John R.; Zerbe, John I.
In: Jones, Stephen B.; Stanturf, John A., eds. Hardwood forest products opportunities: created and expanding businesses (Lake States, Northeast, Mid-Atlantic): Proceedings of conference; 1989 October 16–19; Pittsburg, PA. Pittsburg, PA: Penn State/Pennsylvania Department of Commerce; 1990: 64–69.

This report explains the involvement of the Forest Products Laboratory with other research institutes and industry in helping to create a competitive edge for forest products. The development of new products and methods in both the secondary manufacturing of hardwoods and the primary processing of lumber are described. The efforts to identify research areas that focus on new market opportunities for wood products are outlined. And,

a summary is given on the application of new technologies, which include robotics, computer numerical control, image analysis, and expert systems, and on what these developments signify for the future.

64. Hardwood Resource Availability: Quality and Quantity

Harpole, George B.
In: Executive Summaries; 43rd annual meeting; 1988 June; Reno, NV. Madison, WI: Forest Products Research Society; 1988: 45–46.

A recent assessment of forest productivity by the USDA Forest Service illustrated that the net annual growth of hardwoods in the United States has regularly exceeded annual removal during the past 35 years. This paper discusses the U.S. hardwood inventory and the expected increase in hardwood utilization for production of paper, particleboard, and sawn lumber and timbers. Emerging demands for the reconstruction of bridges can also be expected to be partially supplied from hardwood timbers. With these expected increases in hardwood utilization, corresponding increases in annual growth can be expected to eventually reach a growth-to-removal balance among managed hardwood forests in the United States.

65. Demographic Change and Its Impact on Forest Resource Requirements

Marcin, Thomas C.
In: Forestry on the frontier: Proceedings of the 1989 Society of American Foresters national convention; 1989 September 24–27; Spokane, WA. Bethesda, MD: Society of American Foresters; 1990: 30–37.

Major demographic changes are now occurring that will profoundly affect the demand for forest products and the use of our forests. An understanding of how changing demographic trends affect markets for goods and services and societal attitudes is particularly important for the long-term analysis of forest resource requirements. This paper describes the major demographic changes taking place in the United States and their possible impacts on forest resource use. It also briefly reports on some broader world population trends and their implications for forest products markets and world forestry.

66. Dynamic Integration of Process and Product Innovation Research

Marcin, Thomas C.
In: Executive Summaries; 43rd annual meeting; 1988 June; Reno, NV. Madison, WI: Forest Products Research Society; 1988: 31–33.

A new product concept like FPL Spaceboard requires a comprehensive systematic evaluation of prospective markets. This paper proposes the use of a framework for evaluating two specific products based upon spaceboard technology.

67. Capacity Change in the Forest Products Industry: An Evaluation of Modeling Approaches

Plantinga, Andrew J.; Lange, William J.; Skog, Kenneth E.
In: Proceedings of the forest sector analysis symposium; 1989 August 13–18; Soderfors, Sweden. Uppsala, Sweden: The Swedish University of Agricultural Sciences; 1989: 141–157.

This paper reviews and evaluates approaches to modeling capacity change in the forest products industry. The objective is to provide an understanding of capacity change and insight into the strengths and weaknesses of past modeling approaches. The goal is to assist in improving these approaches for the next generation of forest products industry models. This paper is divided into five sections: (1) the theory of capacity change, (2) one-variable approaches, (3) multivariable approaches, (4) case studies, and (5) discussion.

68. Forecasting Technological Change in Softwood Lumber Processing

Skog, Kenneth E.
In: Proceedings, 23d annual Pacific Northwest regional economic conference; 1989 April 26–28; Corvallis, OR. Seattle, WA: Northwest Policy Center; 1989: 55–62.

This paper explains the rationale and procedure used to project trends in softwood lumber recovery and processing costs.

69. Using Forest Sector Models to Estimate the Potential Impact of Current Wood Utilization Research

Skog, Kenneth; Durbak, Irene; Howard, James; Spelter, Henry
In: Proceedings of the forest sector analysis symposium; 1989 August 13–18; Soderfors, Sweden. Uppsala, Sweden: The Swedish University of Agricultural Sciences; 1989: 105–121.

Using models to estimate the effect of research on the relative adequacy of future timber supplies, this paper reports on how selected current USDA Forest Service research may, in association with other research, development, and technology transfer efforts, change future timber consumption and prices. Other important potential benefits of utilization research, such as improved worker or consumer safety, are not evaluated.

70. Potential Timber Market Impact of Current Wood Utilization Research

Skog, Kenneth; Durbak, Irene; Howard, James; Spelter, Henry; Bradley, Dennis; Adams, Darius; Haynes, Richard
In: Forestry on the frontier: Proceedings of the 1989 Society of American Foresters national convention; 1989 September 24–27; Spokane, WA. Bethesda, MD: Society of American Foresters; 1990: 319–326.

To analyze the potential effect of research on the relative adequacy of future U.S. timber supplies, selected current Forest Service research was evaluated in association with other research, development, and technology transfer efforts. Seven areas of Forest Service research were identified that might influence timber markets. This paper explains the research being conducted in each area and the resultant anticipated technology changes. Then, the potential impact of the research areas is explained.

71. Changes in Structural Panel Technologies and Economies

Spelter, Henry
In: Proceedings, 23d annual Pacific Northwest regional economic conference; 1989 April 26–28; Corvallis, OR. Seattle, WA: Northwest Policy Center; 1989: 63–69.

Several improvements in processing plywood have reduced the cost of manufacturing plywood and brought them in line with those of other panel technologies. This paper describes these improvements and compares plywood economics in the Pacific Northwest with those of structural wood-based panel producers elsewhere.

72. PLYMAP—A Computer Simulation Model of the Rotary Peeled Softwood Plywood Manufacturing Process

Spelter, Henry
USDA Forest Serv. Gen. Tech. Rep. FPL–GTR–65; 1990. 54 p.

This report documents a simulation model of the plywood manufacturing process. Its purpose is to enable a user to make quick estimates of the economic impact of a particular process change within a mill. The program was designed to simulate the processing of plywood within a relatively simplified mill design. Within that limitation, however, it allows a wide range of options to be incorporated so as to customize the program to a variety of situations.

Tropical Wood Utilization

73. Processing for Effective Wood Use

Maeglin, Robert R.; Montrey, Henry M.
In: All division 5 conference; 1988 May; Sao Paulo, Brazil. Sao Paulo, Brazil: International Union of Forestry Research Organizations; 1988: 87–97. Vol. 2.

This paper discusses the need to effectively process wood from tropical forests. The reasons for this need are defined in this paper by explaining the need for increasing effectiveness of wood use, for placing value on the wood resource, and for meeting the increasing worldwide need for wood for shelter and commodities.

Wood Bonding Systems

Hydroxymethylated Lignin-Bonded Douglas-Fir Flakeboard

Jokerst, R.W.
Forest Prod. J. 40(2): 45–48; 1990.

Available from Forest Products Research Society, 2801 Marshall Court, Madison, WI 53705. Cost $2 each, with $5 minimum, plus 10 percent postage and handling.

In this paper, the hydroxymethylated lignin adhesive system was used as a binder for Douglas-fir flakeboards. The flakeboards were subjected to a series of standard tests, and their performance was measured.

74. Formaldehyde Liberation and Cure Behavior of Urea-Formaldehyde Resins

Myers, George E.; Koutsky, James A.
Holzforschung. 44(2): 117–126; 1990.

The primary goal of this research was to determine the influence of several structural and compositional variables on the hydrolytic stability of cured urea-formaldehyde resins, with emphasis on effects of resin acidity. The variables included formaldehyde to urea molar ratio, degree of cure, concentration and type of acidic cure catalysts, pH, and the presence of potential acid-neutralizing additives.

Compatibility of Nonacidic Waterborne Preservatives With Phenol-Formaldehyde Adhesive

Vick, Charles B.; De Groot, Rodney C.; Youngquist, John
Forest Prod. J. 40(2): 16–22; 1990.

Available from Forest Products Research Society, 2801 Marshall Court, Madison, WI 53705. Cost $2 each, with $5 minimum, plus 10 percent postage and handling.

This research on compatibility of preservative with phenol-formaldehyde adhesive represents the first phase in a multiphase research program to investigate the feasibility of manufacturing preservatively treated composite panel products from veneer, flakes, and fibers. Other research is expected to cover mechanical properties, dimensional stability, resistance to decay and insects, feasibility of diffusion treatments, and full-scale performance tests.

Special Items

Archaeological Wood: Properties, Chemistry and Preservation

Rowell, Roger M.; Barbour, R. James, eds.
American Chemical Society, Washington, DC. 472 p.

Available from American Chemical Society, Distribution Office, Department 225, 1155 16th Street, NW, Washington DC 20036. Telephone: 1–800–227–5558. Advances Series No. 225. Cost: $79.95.

This 17-chapter volume brings the science of chemistry to the techniques of preserving archaeological wood. The discussion in this volume is based on knowledge of the structure of wood and the mechanisms of its degradation. It includes discussions on changes brought about by decay, biopredators, radiation curing, freeze drying, museum environments, the ethics of conservation, and value systems for choosing among the qualities of wood that can be preserved. This book is published by the American Chemical Society as part of its Advances in Chemistry Series.

Veneer Product Size Analysis—User's Guide IMPROVE System, Version 1.0 (2/15/90)

February 1990, 73 p.

Target Set Reduction—User's Guide IMPROVE System, Version 1.0 (3/15/90)

March 1990, 36 p.

State and Private Forestry and Forest Products Laboratory

Veneer Product Size Analysis—User's Guide includes the software and instructions for a routine designed to help mill personnel assess veneer sizing performance. The routine calculates average peel thicknesses and clip widths and their associated size variations. Initial studies of veneer peel thickness and clip widths are used to evaluate veneer sizing by individual machine centers. Results from the initial studies are then used to set up a size control monitoring system with daily checks of veneer sizing quality. The monitoring systems, called control charts, indicate when significant problems occur, aiding in quick and decisive corrective action.

The result is an ongoing veneer size control system that ensures veneer is being manufactured as accurately as possible and that mismanufacture will be detected quickly. The initial study takes about 1 day with minimum staffing. The followup daily monitoring requires only about 15 minutes for each machine center, two or three times each day.

A supplemental field manual and a background paper entitled "Veneer Product Size Quality Control" are also available.

Target Set Reduction—User's Guide includes the software and instructions for a routine to help sawmill owners and operators quantify monetary losses due to tolerating oversized lumber and excessive lumber variation. The routine also quantifies the amount of oversizing and setting increment for final target set reduction for a particular size class-breakdown system combination. Values derived from *Target Set Reduction* can actually be implemented in a given system.

Veneer Product Size Analysis, a Veneer Manufacturing Program routine, and *Target Set Reduction*, a Lumber Manufacturing Program routine, are part of the IMPROVE Program. IMPROVE (Integrated Mill Production and Recovery Options for Value and Efficiency) is a package of quick, easily understood, and effective tools for measuring and improving the efficiency of sawmills, veneer mills, and plywood plants. Its data collection procedures and computer software combine several successful, existing, recovery improvement programs with the latest in technological and research developments.

Information on software and documentation availability may be obtained by writing Stan Lunstrum, State and Private Forestry, Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705–2398.

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